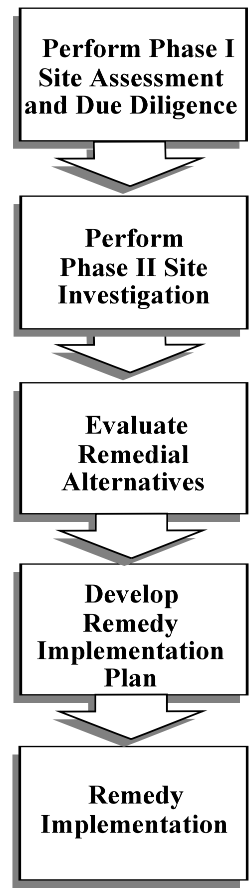
Chapter 4
Phase II Site Investigation



Background

Data collected during the Phase I site assessment may conclude that contaminant(s) exist at the site and/or that further study is necessary to determine the extent of contaminants. The purpose of a Phase II site investigation is to give planners and decision-makers objective and credible data about the contamination at a brownfields site to help them develop an appropriate contaminant management strategy. A site investigation is typically conducted by an environmental professional. This process evaluates the following types of data:

- Types of contamination present;
- Cleanup and reuse goals;
- Length of time required to reach cleanup goals;
- Post-treatment care needed; and
- Costs.

A site investigation involves setting appropriate data quality goals based upon brownfields redevelopment goals, using appropriate screening levels for the contaminants, and conducting environmental sampling and analysis.

Data gathering in a site investigation may typically include soil, water, and air sampling to identify the types, quantity, and extent of contamination in these various environmental media. The types of data used in a site investigation can vary from compiling existing site data (if adequate), to conducting limited sampling of the site, to mounting an extensive contaminant-specific or site-specific sampling effort. Planners should use knowledge of past facility operations whenever possible to focus the site evaluation on those process areas where pollutants were stored, handled, used, or disposed. These will be the areas where potential contamination will be most readily identified. Generally, to minimize costs, a site investigation begins with limited sampling (assuming readily available data does not adequately characterize the type and extent of contamination on the site) and proceed to more comprehensive sampling if needed (e.g., if the initial sampling could not identify the geographical limits of contamination). Exhibit 4-1 shows a flow chart of the site investigation process.

Various environmental companies provide site investigation services. Additional information regarding selection of a site investigation service can be found in *Assessing Contractor Capabilities for Streamlined Site Investigations* (EPA/542-R-00-001, January 2000).

Phase II Site Investigation

Sample the Site to Identify the Type, Quantity, and Extent of the Contamination

Set Data Quality Objectives (DQO)

DQOs are qualitative and quantitative statements specified to ensure that data of known and appropriate quality are obtained. The DQO process is a series of planning steps, typically as follows:

- State the problem
- Identify the decision
- Identify inputs to the decision
- Define the study boundaries
- Develop a decision rule
- Specify limits on decision errors

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Establish Screening Levels

Establish an appropriate set of screening levels for contaminants in soil, water, and/or air using an appropriate risk-based method, such as:

- EPA Soil Screening Guidance (EPA/R-96/128)
- Generic screening levels developed by states for industrial and residential use

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Conduct Environmental Sampling and Analysis

Conduct environmental sampling and analysis. Typically Site Investigation begins with limited sampling, leading to a more comprehensive effort. Sampling and analysis considerations include:

- A screening analysis tests for broad classes of contaminants, while a contaminant-specific analysis provides a more accurate, but more expensive, assessment
- A field analysis provides immediate results and increased sampling flexibility, while laboratory analysis provides greater accuracy and specificity

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Write Report

Write report to document sampling findings. The report should discuss the DQOs, methodologies, limitations, and possible cleanup technologies and goals

Exhibit 4-1. Flow Chart of the Site Investigation Process

This chapter provides a general approach to site evaluation; planners and decision-makers should expand and refine this approach for site-specific use at their own facilities.

Setting Data Quality Objectives

While it is not easy, and probably impossible, to completely characterize the contamination at a site, decisions still have to be made. EPA's Data Quality Objectives (DQO) process provides a framework to make decisions under circumstances of data uncertainty. The DQO process uses a systematic approach that defines the purpose, scope, and quality requirements for the data collection effort. The DQO process consists of the following seven steps (EPA 2000):

- *State the problem.* Summarize the contamination problem that will require new environmental data, and identify the resources available to resolve the problem and to develop the conceptual site model.
- *Identify the decision* that requires new environmental data to address the contamination problem.
- *Identify the inputs to the decision.* Identify the information needed to support the decision and specify which inputs require new environmental measurements.
- *Define the study boundaries.* Specify the spatial and temporal aspect of the environmental media that the data must represent to support the decision.
- *Develop a decision rule.* Develop a logical "if ...then ..." statement that defines the conditions that would cause the decision-maker to choose among alternative actions.
- *Specify limits on decision errors.* Specify the decision maker's acceptable limits on decision errors, which are used to establish performance goals for limiting uncertainty in the data.
- *Optimize the design for obtaining data.* Identify the most resource-effective sampling and analysis design for generating data that are expected to satisfy the DQOs.

Please refer to *Data Quality Objectives Process for Hazardous Waste Site Investigations* (EPA 2000) for more detailed information on the DQO process.

Establish Screening Levels

During the initial stages of a site investigation, planners should establish an appropriate set of screening levels for contaminants in soil, water, and/or air. Screening levels are risk-based benchmarks that represent concentrations of chemicals in environmental media that do not pose an unacceptable risk. Sample analyses of soils, water, and air at the facility can be compared with these benchmarks. If onsite contaminant levels exceed the screening levels, further investigation will be needed to determine if and to what extent cleanup is appropriate. If contaminant concentrations are below the screening level, for the intended use, no action is required.

Some states have developed generic screening levels (e.g., for industrial and residential use), and EPA's *Soil Screening Guidance* (EPA/540/R-96/128) includes generic screening levels for many contaminants. Generic screening levels may not account for site-specific factors that affect the concentration or migration of contaminants. Alternatively, screening levels can be developed using site-specific factors. While site-specific screening levels can more effectively incorporate elements unique to the site, developing site-specific standards is a time- and resource-intensive process. Planners should contact their state environmental offices and/or EPA regional offices for assistance in using screening levels and in developing site-specific screening levels.

Risk-based screening levels are based on calculations and models that determine the likelihood that exposure of a particular organism or plant to a particular level of a contaminant would result in a certain adverse effect. Risk-based screening levels have been developed for tap water, ambient air, fish, and soil. Some states or EPA regions also use regional background levels (or ranges) of contaminants in soil and Maximum Contaminant Levels (MCLs) in water established under the Safe Drinking Water Act as screening levels for some chemicals. In addition, some states and/or EPA regional offices have developed equations for converting soil screening levels to comparative levels for the analysis of air and groundwater.

When a contaminant concentration exceeds a screening level, further site assessment activities (such as sampling the site at strategic locations and/or performing more detailed analysis) are needed to determine whether: (1) the concentration of the contaminant is relatively low and/or the extent of contamination is small and does not warrant cleanup for that particular chemical, or (2) the concentration or extent of contamination is high, and that site cleanup is needed (See Chapter 5, Contaminant Management, for more information.)

Using EPA's soil screening guidance for an initial brownfields investigation may be beneficial if no industrial screening levels are available or if the site may be used for residential purposes. However, it should be noted that EPA's soil screening guidance was designed for high-risk, Tier I sites, rather than brownfields, and conservatively assumes that future reuse will be residential. Using this guidance for a non-residential land use project could result in overly conservative screening levels.

In addition to screening levels, EPA regional offices and some states have developed cleanup levels, known as corrective action levels. If contaminant concentrations are above corrective action levels, a cleanup action must be pursued. Screening levels should not be confused with corrective action levels; Chapter 5, Contaminant Management, provides more information on corrective action levels.

Conduct Environmental Sampling and Data Analysis

Environmental sampling and data analysis are integral parts of a site investigation process. Many different technologies are available to perform these activities, as discussed below.

Levels of Sampling and Analysis

There are two levels of sampling and analysis: screening and contaminant-specific. Planners are likely to use both levels at different stages of the site investigation.

- *Screening.* Screening sampling and analysis use relatively low-cost technologies to take a limited number of samples at the most likely points of contamination and analyze them for a limited number of parameters. Screening analyses often test only for broad classes of contaminants, such as total petroleum hydrocarbons, rather than for specific contaminants, such as benzene or toluene. Screening is used to narrow the range of areas of potential contamination and reduce the number of samples requiring further, more costly, analysis. Screening is generally performed on site, with a small percentage of samples (e.g., generally 10 percent) submitted to a state-approved laboratory for a full organic and inorganic screening analysis to validate or clarify the results obtained.

  Some geophysical methods are used in site assessments because they are noninvasive (i.e., do not disturb environmental media as sampling does). Geophysical methods are commonly used to detect underground objects that might exist at a site, such as USTs, dry wells, and drums. The two most common and cost-effective technologies used in geophysical surveys are ground-penetrating radar and electromagnetics. Table C-1 in Appendix C contains an overview of geophysical methods. For more information on screening (including geophysical) methods, please refer to *Subsurface Characterization and Monitoring Techniques: A Desk Reference Guide* (EPA/625/R-93003a).

- *Contaminant-specific.* For a more in-depth understanding of contamination at a site (e.g., when screening data are not detailed enough), it may be necessary to analyze samples for specific contaminants. With contaminant-specific sampling and analysis, the number of parameters analyzed is much greater than for screening-level sampling, and analysis includes more accurate, higher-cost field and laboratory methods. Samples are sent to a state-approved laboratory to be tested under rigorous protocols to ensure high-quality results. Such analyses may take several weeks. For some contaminants, innovative field technologies are as capable, or nearly as capable, of achieving the accuracy of laboratory technologies, which allows for a rapid turnaround of the results. The principal benefit of contaminant-specific analysis is the high quality and specificity of the analytical results.

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> Elizabeth, New Jersey
> A Brownfields Success Story:
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> ONEJ Corporation, the New Jersey Department of Environmental Protection, and the New Jersey Economic Development Authority worked together to cleanup a 166-acre landfill site that is now the Jersey Gardens Mall. The mall has resulted in $219 million in private investments and an estimated $4 to $5 million in new annual tax revenues. The mall can also be credited with creating .....

New Jersey Brownfields Program. Office of State Planning. New Jersey Brownfields A New Opportunity, June 2000.

Increasing the Certainty of Sampling Results

Statistical Sampling Plan. Statistical sampling plans use statistical principles to determine the number of samples needed to accurately represent the contamination present. With the statistical sampling method, samples are usually analyzed with highly accurate laboratory or field technologies, which increase costs and take additional time. Using this approach, planners can consult with regulators and determine in advance specific measures of allowable uncertainty (e.g., an 80 percent level of confidence with a 25 percent allowable error).

Use of Lower-cost Technologies with Higher Detection Limits to Collect a Greater Number of Samples. This approach provides a more comprehensive picture of contamination at the site, but with less detail regarding the specific contamination. Such an approach would not be recommended to identify the extent of contamination by a specific contaminant, such as benzene, but may be an excellent approach for defining the extent of contamination by total organic compounds with a strong degree of certainty.

Site Investigation Technologies

This section discusses the differences between using field and laboratory technologies and provides an overview of applicable site investigation technologies. In recent years, several innovative technologies that have been field-tested and applied to hazardous waste problems have emerged. In many cases, innovative technologies may cost less than conventional techniques and can successfully provide the needed data. Operating conditions may affect the cost and effectiveness of individual technologies.

Field versus Laboratory Analysis

The principal advantages of performing field sampling and field analysis are that results are immediately available and more samples can be taken during the same sampling event; also, sampling locations can be adjusted immediately to clarify the first round of sampling results, if warranted. This approach may reduce costs associated with conducting additional sampling events after receipt of laboratory analysis. Field assessment methods have improved significantly over recent years; however, while many field technologies may be comparable to laboratory technologies, some field technologies may not detect contamination at levels as low as laboratory methods, and may not be contaminant-specific. To validate the field results or to gain more information on specific contaminants, a small percentage of the samples can be sent for laboratory analysis. The choice of sampling and analytical procedures should be based on Data Quality Objectives established earlier in the process, which determine the quality (e.g., precision, level of detection) of the data needed to adequately evaluate site conditions and identify appropriate cleanup technologies.

Sample Collection Technologies

Sample collection technologies vary widely, depending on the medium being sampled and the type of analysis required, based on the Data Quality Objectives (see the section on this subject earlier in this document). For example, soil samples are generally collected using spoons, scoops, and shovels, while subsurface sampling is more complex. The selection of a subsurface sample collection technology depends on the subsurface conditions (e.g., consolidated materials, bedrock), the required sampling depth and level of analysis, and the extent of sampling anticipated. If subsequent sampling efforts are likely, installing semipermanent well casings with a well-drilling rig may be appropriate. If limited sampling is expected, direct push methods, such as cone penetrometers, may be more cost-effective. The types of contaminants will also play a key role in the selection of sampling methods, devices, containers, and preservation techniques.

Groundwater contamination should be assessed in all areas, particularly where solvents or acids have been used. Solvents can be very mobile in subsurface soils; and acids, such as those used in finishing operations, increase the mobility of metal compounds. Groundwater samples should be taken at and below the water table in the surficial aquifer. Cone penetrometer technology is a cost-effective approach for collecting these samples. The samples then can be screened for contaminants using field methods such as:

- pH meters to screen for the presence of acids;
- Colormetric tubes to screen for volatile organics; and
- X-ray fluorescence to screen for metals.

Tables C-2 through C-4 in Appendix C list more information on various sample collection technologies, including a comparison of detection limits and costs.

The following chapter describes various contaminant management strategies that are available to the developer.